19. DATA SHEETS ....Continued

DATA SHEET 16
15.12 ANTILOCK FUNCTIONAL FAILURE @ LLVW (S7.8)

VEHICLE:		NHTSA NUMBER:		DATE:	
TEMP.:		WIND VELOCITY:		ROAD PFC:	
ODOMETER START:		ODOMETER FINISH:			

Test Weight: Total = _____ kg; Front = _____ kg; Rear = ____kg

S7.8.1 Vehicle Conditions:

A. Vehicle Load: LLVW

B. Transmission Position: In Neutral

S.7.8.2 Test Conditions and Procedures:
NOTE: STOP IN SHORTEST DISTANCE ACHIEVABLE (BEST EFFORT) ON ALL STOPS

IBT: >65ºC,<100ºC

TEST SPEED: 100 km/h

PEDAL FORCE: 65 N minimum to 500 N maximum

WHEEL LOCKUP:
No lockup of any wheel for longer than 0.1 seconds at speeds > 15 km/h

NO. OF RUNS: 6 stops

TEST SURFACE: PFC of 0.9

WIND SPEED: Not greater than 5 m/s

FAILURE SIMULATION:

A. Disconnect the functional power source, or any electrical connector that creates a functional failure.

Record method used:_____

19. DATA SHEETS ....Continued

B. Brake system indicator light activated? YES ___ NO ___

C. Restore the system to normal at the completion of this test.
NOTE: If more than one antilock brake subsystem is provided, repeat test for each subsystem.

S.7.8.3 Performance Requirements:

*STOPPING DISTANCE: <85 m from 100 km/h speed

VISUAL DATA

Stop No.	Test Speed (km/h)	Initial Brake Temperature (C)		Stopping Distance (m)	Stopping Direction	Pedal Force (N)	Vehicle Decel. (m/s²)	Wheel Lockup	Stay in Lane
		Front	Rear			Maximum	Maximum		
1									
2									
3									
4									
5									
6									

* $S<0.10V+0.0075V^2$ (Stopping Distance formula for vehicles with top speed <100 km/h)

Comments:

19. DATA SHEETS ....Continued

RECORDED DATA

Stop No.	Test Speed (km/h)	Initial Brake Temp. (C)		Stopping Distance (m)	Pedal Force (N)			Vehicle Decel. (m/s²)		Wheel Lockup
		Front	Rear		Min.	Max.	Avg.	Max.	Avg.	
1										
2										
3										
4										
5										
6										

* $S<0.10V+0.0075V^2$ (Stopping Distance formula for vehicles with top speed <100 km/h)

COMPLIANCE: YES _____ NO _____

Comments:

DRIVER:_____ OBSERVER:_____

DATE: _____

19. DATA SHEETS ....Continued

DATA SHEET 17
15.13 Variable Brake Proportioning System Functional Failure @ LLVW(S7.9)

VEHICLE:		NHTSA NUMBER:		DATE:	
TEMP:		WIND VELOCITY:		ROAD PFC:	
ODOMETER START:		ODOMETER FINISH:			

Test Weight: Total = _____ kg; Front = _____ kg; Rear = _____ kg

Is vehicle equipped with variable proportioning? Yes ___ No ___

If "No", skip this section and continue to section S7.10.1

S.7.9.1 Vehicle Conditions

A. Vehicle Load: LLVW

B. Transmission Position: In Neutral

S.7.9.2 Test Conditions and Procedures:

NOTE: STOP IN SHORTEST DISTANCE ACHIEVABLE (BEST EFFORT) ON ALL STOPS.

IBT: >65ºC, <100ºC

TEST SPEED: 100 km/h

PEDAL FORCE: 65 N minimum to 500 N maximum

WHEEL LOCKUP:
No lockup of any wheel for longer than 0.1 seconds at speeds > 15 km/h

NUMBER OF RUNS: 6 stops

TEST SURFACE: PFC of 0.9

WIND SPEED: Not greater than 5 m/s

19. DATA SHEETS ....Continued

FAILURE SIMULATION:

A. Disconnect the functional power source or mechanical linkage to render the variable brake proportioning system inoperative.

Record method used: _____

B. Brake system indicator light activated? Yes ___ No ___

C. Restore the system to normal at the completion of this test.

NOTE: If more than one variable brake proportioning subsystem is provided, repeat the test for each subsystem.

S.7.9.3 Performance Requirements:

*STOPPING DISTANCE: <110 m from 100 km/h speed

VISUAL DATA

Stop No.	Test Speed (km/h)	Initial Brake Temperature (C)		Stopping Distance (m)	Stopping Direction	Pedal Force (N)	Vehicle Decel. (m/s²)	Wheel Lockup	Stay in Lane
		Front	Rear			Max.	Max.		
1									
2									
3									
4									
5									
6									

Comments:

19. DATA SHEETS ....Continued

RECORDED DATA

Stop No.	Test Speed (km/h)	Initial Brake Temp. (C)		Stopping Distance (m)	Pedal Force (N)			Vehicle Decel. (m/s²)		Wheel Lockup
		Front	Rear		Min.	Max.	Avg.	Max.	Avg.	
1										
2										
3										
4										
5										
6										

* $S<0.10V+0.0100V^2$ (Stopping Dist. formula for vehicles with top speed <100 km/h)

COMPLIANCE: YES _____ NO _____

Comments:

DRIVER:_____ OBSERVER:_____

DATE: _____

19. DATA SHEETS ....Continued

DATA SHEET 18
15.14 HYDRAULIC CIRCUIT FAILURE # 1 @ LLVW (S7.10)

VEHICLE:		NHTSA NUMBER:		DATE:	
TEMP.:		WIND VELOCITY:		ROAD PFC:	
ODOMETER START:		ODOMETER FINISH:			

Test Weight: Total = _____ kg; Front = _____ kg; Rear = ____ kg

S.7.10 Hydraulic Circuit Failure CIRCUIT NO. 1

S.7.10.1 General Information: This test is for vehicles manufactured with a split service brake system.

S.7.10.2 Vehicle Conditions:

A. Vehicle Load: LLVW

B. Transmission Position: In Neutral

S.7.10.3 Test Conditions and Procedures:
NOTE: STOP IN SHORTEST DISTANCE ACHIEVABLE (BEST EFFORT) ON ALL STOPS.

IBT: >65ºC, <100ºC

TEST SPEED: 100 km/h

PEDAL FORCE: 65 N minimum to 500 N maximum

WHEEL LOCKUP:
No lockup of any wheel for longer than 0.1 seconds at speeds > 15 km/h

NUMBER OF RUNS: 4 stops

TEST SURFACE: PFC of 0.9

WIND SPEED: Not greater than 5 m/s

19. DATA SHEETS ....Continued

FAILURE SIMULATION:

Method of simulating failure: _____

System Portion Failed: _____

Determine the control force pressure level or fluid level necessary to activate the brake warning indicator.

A. Force to activate light: _____ , or

B. Fluid level required to activate light: _____

Make stops after the brake warning indicator has been activated.

C. Restore the system to normal at the completion of this test.

S.7.10.4 Performance Requirements:

*STOPPING DISTANCE: <168 m from 100 km/h speed

VISUAL DATA

Stop No.	Test Speed (km/h)	Initial Brake Temperature (C)		Stopping Distance (m)	Stopping Direction	Pedal Force (N)	Vehicle Decel. (m/s²)	Wheel Lockup	Stay in Lane
		Front	Rear			Maximum	Maximum		
1									
2									
3									
4									

Comments:

19. DATA SHEETS ....Continued

RECORDED DATA

Stop No.	Test Speed (km/h)	Initial Brake Temp. (C)		Stopping Distance (m)	Pedal Force (N)			Vehicle Decel. (m/s²)		Wheel Lockup
		Front	Rear		Min.	Max.	Avg.	Max.	Avg.	
1										
2										
3										
4										

*S<0.10V+0.0100V² (Stopping Dist. formula for vehicles with top speed <100 km/h)

COMPLIANCE: YES _____ NO _____

DRIVER:_____ OBSERVER:_____

DATE: _____

19. DATA SHEETS ....Continued

DATA SHEET 19
15.14 HYDRAULIC CIRCUIT FAILURE # 2 @ LLVW (S7.10)

VEHICLE:		NHTSA NUMBER:		DATE:	
TEMP.:		WIND VELOCITY:		ROAD PFC:	
ODOMETER START:		ODOMETER FINISH:			

Test Weight: Total = _____ kg; Front = _____ kg; Rear = ____ kg

REPEAT 15.14 With Hydraulic Circuit #2 Failure

S.7.10.4 Performance Requirements:

*STOPPING DISTANCE: <168 m from 100 km/h speed

VISUAL DATA

Stop No.	Test Speed (km/h)	Initial Brake Temperature (C)		Stopping Distance (m)	Stopping Direction	Pedal Force (N)	Vehicle Decel. (m/s²)	Wheel Lockup	Stay in Lane
		Front	Rear			Max.	Max.		
1									
2									
3									
4									

Comments:

19. DATA SHEETS ....Continued

RECORDED DATA

Stop No.	Test Speed (km/h)	Initial Brake Temp. (C)		Stopping Distance (m)	Pedal Force (N)			Vehicle Decel. (m/s²)		Wheel Lockup
		Front	Rear		Min.	Max.	Avg.	Max.	Avg.	
1										
2										
3										
4										

* $S<0.10V+0.0100V^2$ (Stopping Dist. formula for vehicles with top speed <100 km/h)

COMPLIANCE: YES _____ NO _____

Comments:

DRIVER:_____ OBSERVER:_____

DATE: _____

19. DATA SHEETS ....Continued

DATA SHEET 20
15.15 HYDRAULIC CIRCUIT FAILURE #1 @ GVWR (S7.10)

VEHICLE:		NHTSA NUMBER:		DATE:	
TEMP.:		WIND VELOCITY:		ROAD PFC:	
ODOMETER START:		ODOMETER FINISH:			

Test Weight: Total = _____ kg; Front = _____ kg; Rear = ____ kg

REPEAT 15.14 With Hydraulic Circuit #1 Failure @ GVWR

S.7.10.4 Performance Requirements:

*STOPPING DISTANCE: <168 m from 100 km/h speed

VISUAL DATA

Stop No.	Test Speed (km/h)	Initial Brake Temperature (C)		Stopping Distance (m)	Stopping Direction	Pedal Force (N)	Vehicle Decel. (m/s²)	Wheel Lockup	Stay in Lane
		Front	Rear			Maximum	Maximum		
1									
2									
3									
4									

Comments:

19. DATA SHEETS ....Continued

RECORDED DATA

Stop No.	Test Speed (km/h)	Initial Brake Temp. (C)		Stopping Distance (m)	Pedal Force (N)			Vehicle Decel. (m/s²)		Wheel Lockup
		Front	Rear		Min.	Max.	Avg.	Max.	Avg.	
1										
2										
3										
4										

*S<0.10V+0.0100V² (Stopping Dist. formula for vehicles with top speed <100 km/h)

COMPLIANCE: YES _____ NO _____

Comments:

DRIVER:_____ OBSERVER:_____

DATE: _____

19. DATA SHEETS ....Continued

DATA SHEET 21
15.15 HYDRAULIC CIRCUIT FAILURE # 2 @ GVWR (S7.10)

VEHICLE:		NHTSA NUMBER:		DATE:	
TEMP.:		WIND VELOCITY:		ROAD PFC:	
ODOMETER START:		ODOMETER FINISH:			

Test Weight: Total = _____ kg; Front = _____ kg; Rear = ____ kg

REPEAT 15.14 With Hydraulic Circuit #2 Failure @ GVWR

S.7.10.4 Performance Requirements:

*STOPPING DISTANCE: <168 m from 100 km/h speed

VISUAL DATA

Stop No.	Test Speed (km/h)	Initial Brake Temperature (C)		Stopping Distance (m)	Stopping Direction	Pedal Force (N)	Vehicle Decel. (m/s²)	Wheel Lockup	Stay in Lane
		Front	Rear			Max.	Max.		
1									
2									
3									
4									

Comments:

19. DATA SHEETS ....Continued

RECORDED DATA

Stop No.	Test Speed (km/h)	Initial Brake Temp. (C)		Stopping Distance (m)	Pedal Force (N)			Vehicle Decel. (m/s²)		Wheel Lockup
		Front	Rear		Min.	Max.	Avg.	Max.	Avg.	
1										
2										
3										
4										

* S<0.10V+0.0100V² (Stopping Distance formula for vehicles with top speed <100 km/h)

COMPLIANCE: YES _____ NO _____

Comments:

DRIVER:_____ OBSERVER:_____

DATE: _____

19. DATA SHEETS ....Continued

DATA SHEET 22
15.16 ANTILOCK FUNCTIONAL FAILURE @ GVWR (S7.8)

VEHICLE:		NHTSA NUMBER:		DATE:	
TEMP.:		WIND VELOCITY:		ROAD PFC:	
ODOMETER START:		ODOMETER FINISH:			

Test Weight: Total = _____ kg; Front = _____ kg; Rear = ____ kg

REPEAT 15.12 WITH VEHICLE AT GVWR

S.7.8.3 Performance Requirements:

*STOPPING DISTANCE: <85 m from 100 km/h speed

VISUAL DATA

Stop No.	Test Speed (km/h)	Initial Brake Temperature (C)		Stopping Distance (m)	Stopping Direction	Pedal Force (N)	Vehicle Decel. (m/s²)	Wheel Lockup	Stay in Lane
		Front	Rear			Max.	Max.		
1									
2									
3									
4									
5									
6									

Comments:

19. DATA SHEETS ....Continued

RECORDED DATA

Stop No.	Test Speed (km/h)	Initial Brake Temp. (C)		Stopping Distance (m)	Pedal Force (N)			Vehicle Decel. (m/s²)		Wheel Lockup
		Front	Rear		Min.	Max.	Avg.	Max.	Avg.	
1										
2										
3										
4										
5										
6										

* $S<0.10V+0.0075V^2$ (Stopping Dist. formula for vehicles with top speed <100 km/h)

COMPLIANCE: YES _____NO _____

Comments:

DRIVER:_____ OBSERVER:_____

DATE: _____

19. DATA SHEETS ....Continued

DATA SHEET 23
5.17 Variable Brake Proportioning System Functional Failure @ GVWR(S7.9)

VEHICLE:		NHTSA NUMBER:		DATE:	
TEMP.:		WIND VELOCITY:		ROAD PFC:	
ODOMETER START:		ODOMETER FINISH:			

Test Weight: Total = _____ kg; Front = _____ kg; Rear = _____ kg

\REPEAT 15.13 WITH VEHICLE AT GVWR

S.7.9.3 Performance Requirements:

*STOPPING DISTANCE: <110 m from 100 km/h speed

VISUAL DATA

Stop No.	Test Speed (km/h)	Initial Brake Temperature (C)		Stopping Distance (m)	Stopping Direction	Pedal Force (N)	Vehicle Decel.(m/s²)	Wheel Lockup	Stay in Lane
		Front	Rear			Max.	Max.		
1									
2									
3									
4									
5									
6									

Comments:

19. DATA SHEETS ....Continued

RECORDED DATA

Stop No.	Test Speed (km/h)	Initial Brake Temp. (C)		Stopping Distance (m)	Pedal Force (N)			Vehicle Decel. (m/s²)		Wheel Lockup
		Front	Rear		Min.	Max.	Avg.	Max.	Avg.	
1										
2										
3										
4										
5										
6										

* $S<0.10V+0.0100V^2$ (Stopping Dist. formula for vehicles with top speed <100 km/h)

COMPLIANCE: YES _____ NO _____

Comments:

DRIVER:_____ OBSERVER:_____

DATE: _____

19. DATA SHEETS ....Continued

DATA SHEET 24
15.18 Power Brake Unit or Brake Power Assist Unit
Inoperative @ GVWR (System Depleted) (S7.11)

VEHICLE:		NHTSA NUMBER:		DATE:	
TEMP.:		WIND VELOCITY:		ROAD PFC:	
ODOMETER START:		ODOMETER FINISH:			

Test Weight: Total = _____ kg; Front = _____ kg; Rear = ____ kg

S7.11.1 General Information:

This test is for vehicles equipped with one or more brake power units or brake power assist units.

S7.11.2 Vehicle Conditions:

A. Vehicle Load: GVWR

B. Transmission Position: In Neutral

S7.11.3 Test Conditions and Procedures:
NOTE: STOP IN SHORTEST DISTANCE ACHIEVABLE (BEST EFFORT) ON ALL STOPS.

IBT: >65ºC, <100ºC

TEST SPEED: 100 km/h

PEDAL FORCE: 65 N minimum to 500 N maximum

WHEEL LOCKUP:
No lockup of any wheel for longer than 0.1 seconds at speeds > 15 km/h

NUMBER OF RUNS: 6 stops

TEST SURFACE: PFC of 0.9

WIND SPEED: Not greater than 5 m/s

19. DATA SHEETS ....Continued

FAILURE SIMULATION:
Disconnect the primary source of power.
(**Deplete** all reserve power capability.)

Method of rendering inoperative_____

Restore the system to normal at the completion of this test. Repeat test for other power unit if vehicle has more than one.

S7.11.4 Performance Requirements:

*STOPPING DISTANCE: <168 m

VISUAL DATA

Stop No.	Test Speed (km/h)	Initial Brake Temperature (C)		Stopping Distance (m)	Stopping Direction	Pedal Force (N)	Vehicle Decel. (m/s²)	Wheel Lockup	Stay in Lane
		Front	Rear			Max.	Max.		
1									
2									
3									
4									
5									
6									

Comments:

19. DATA SHEETS ....Continued

RECORDED DATA

Stop No.	Test Speed (km/h)	Initial Brake Temp. (C)		Stopping Distance (m)	Pedal Force (N)			Vehicle Decel. (m/s²)		Wheel Lockup
		Front	Rear		Min.	Max.	Avg.	Max.	Avg.	
1										
2										
3										
4										
5										
6										

* $S<0.10V+0.0100V^2$ (Stopping Dist. formula for vehicles with top speed <100 km/h)

COMPLIANCE: YES _____ NO _____

Comments:

DRIVER:_____ OBSERVER:_____

DATE: _____

19. DATA SHEETS ....Continued

DATA SHEET 25
15.19 PARKING BRAKE @ GVWR (S7.12)

VEHICLE:		NHTSA NUMBER:		DATE:	
TEMP.:		WIND VELOCITY:		ROAD PFC:	
ODOMETER START:		ODOMETER FINISH:			

Test Weight: Total = _____ kg; Front = _____ kg; Rear = ____ kg

Parking Brake: Hand Control? _____ Foot Control? _____

S7.12.1 Vehicle Conditions:

A. Vehicle Load: GVWR

B. Transmission Position: In Neutral

NOTE: For vehicles with parking brake systems not utilizing the service brake friction elements, the friction elements of such systems are to be burnished prior to parking brake tests according to the manufacturer's published recommendations as furnished to the purchaser. If no recommendations are furnished, test the system in an unburnished condition. If recommendations are furnished, record method used._____

S7.12.2 Test Conditions and Procedures:

A. Parking brake systems utilizing service brake friction materials.

IBT: <100°C
(No additional burnishing or artificial heating prior to the start of the parking brake test is allowed).

B. Parking brake systems utilizing non-service brake friction materials.

IBT: Ambient Temperature
(No additional burnishing or artificial heating prior to the start of the parking brake test is allowed).

19. DATA SHEETS ....Continued

PEDAL FORCE:

Hand control: <400 N

Foot control: <500 N

Drive onto 20% grade. Apply service brake just enough to hold vehicle stationary, and shift to Neutral. Apply park brake to force of < 400 N hand control and < 500 N foot control.

Release service brake; if vehicle remains stationary, start the measurement of time. Terminate after 5 minutes. If vehicle is not held stationary, reapply service brake just enough to hold vehicle on the grade. Reapply the specified force to parking lever or pedal (without releasing ratchet mechanism).

Release service brake. If vehicle still doesn't hold, repeat application. If vehicle is not held stationary for 5 minutes after two re-applications, check with engineer for further instructions. Repeat test in the opposite direction.

Did parking brake indicator operate each time the parking brake was applied?

Yes _____ No _____

S7.12.3 Performance Requirements:

The parking brake must hold the vehicle stationary in both directions for 5 minutes.

Comments:

19. DATA SHEETS ....Continued

VISUAL DATA

		20% Grade - Uphill			20% Grade - Downhill		
		Initial Apply	**1st Reapply**	**2nd Reapply**	**Initial Apply**	**1st Reapply**	**2nd Reapply**
Service Brake Force to Hold Vehicle Stationary (N)							
Parking Brake Force Applied (N)							
Number of Clicks (Optional)							
Vehicle Stationary for 5 minutes?							
Initial Brake Temperature (ºC)	Left						
	Right						
	Average						

RECORDED DATA

		20% Grade - Uphill			20% Grade - Downhill		
		Initial Apply	**1st Reapply**	**2nd Reapply**	**Initial Apply**	**1st Reapply**	**2nd Reapply**
Service Brake Force to Hold Vehicle Stationary (N)							
Parking Brake Force Applied (N)							
Initial Brake Temperature (ºC)	Left						
	Right						
	Average						

COMPLIANCE: YES _____ NO _____

Comments:

DRIVER:_____ OBSERVER:_____

DATE: _____

19. DATA SHEETS ....Continued

DATA SHEET 26
15.20 HEATING SNUBS @ GVWR (S7.13)

VEHICLE:		NHTSA NUMBER:		DATE:	
TEMP.:		WIND VELOCITY:		ROAD PFC:	
ODOMETER START:		ODOMETER FINISH:			

Test Weight: Total = ____ kg; Front = _____ kg; Rear = _____ kg

IBT: >55ºC, <65ºC.

Establish IBT before the first brake application. IBT before subsequent snubs are those occurring at the distance intervals.

TRANSMISSION POSITION: In gear

NUMBER OF SNUBS: 15

TEST SPEEDS:
The initial speed for each snub is 120 km/h or 80% of Vmax, whichever is slower. Each snub is terminated at one-half the initial speed.

DECELERATION RATE:
Maintain a constant deceleration rate of 3.0 m/s². Attain the specified deceleration within one second and maintain it for the remainder of the snub.

PEDAL FORCE:
Adjust as necessary to maintain the specified constant deceleration rate.

TIME INTERVAL:
Maintain an interval of 45 seconds between the start of brake applications (snubs).

NOTE 1: Accelerate as rapidly as possible to the initial test speed immediately after each snub.

NOTE 2: Immediately after the 15th snub, accelerate to 100 km/h and commence the hot performance test.

19. DATA SHEETS ....Continued

HEATING SNUBS

VISUAL DATA

NOTE: Modify as needed according to feasibility and instrumentation.

Snub No.	Max. Decel. Rate (m/s²)	Time Interval (sec)	Max. P.F. (N)	Brake Lining Temp. (ºC)				Speed (km/h)	Comments
				LF	RF	LR	RR		
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									

Comments:

19. DATA SHEETS ....Continued

RECORDED DATA

Snub No.	Avg Decel. Rate (m/s²)	Time Interval (sec)	Avg. P.F.	Brake Lining Temp. (ºC)				Speed (km/h)	Comments
				LF	RF	LR	RR		
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									

COMPLIANCE: YES _____ NO _____

Comments:

DRIVER_____ OBSERVER_____

DATE: _____

19. DATA SHEETS ....Continued

DATA SHEET 27
15.21 HOT PERFORMANCE @ GVWR (S7.14)

VEHICLE:		NHTSA NUMBER:		DATE:	
TEMP.:		WIND VELOCITY:		ROAD PFC:	
ODOMETER START:		ODOMETER FINISH:			

Test Weight: Total = ____ kg; Front = _____ kg; Rear = _____ kg

S7.14 Hot Performance: GVWR

IBT: Temperature achieved at completion of heating snubs.

TRANSMISSION POSITION: In neutral

NUMBER OF RUNS: 2 stops

TEST SPEEDS: 100 km/h. If vehicle is incapable of attaining 100 km/h, it is tested at the same speeds used for the cold effectiveness test.

PEDAL FORCE:

Stop No. 1: Average pedal force not greater than the average pedal force recorded during the shortest GVWR cold effectiveness stop.

AVG. Pedal force from cold effectiveness stop:_____ N

NOTE: To insure Average Pedal Force is not GREATER THAN the Average Pedal Force on shortest GVWR cold effectiveness stop, driver can observe instrument panel mounted real time pedal force gauge and maintain a force lower than the average value which must NOT be exceeded.

Stop No. 2: <500 N

WHEEL LOCKUP: No lockup of any wheel for longer than 0.1 seconds at speeds greater than 15 km/h

19. DATA SHEETS ....Continued

Relative and Absolute Performance Requirements:

A. For the 1st hot stop, the stopping distance must be less than or equal to a calculated distance which is based on 60 percent of the deceleration actually achieved on the shortest GVWR cold effectiveness stop. The following equations shall be used in calculating the performance requirement.

$Dc = 0.0386V^2 / (Sc - 0.10V)$

$S = 0.10V + (0.0386V^2 / 0.60Dc)$, where —

Sc = actual stopping distance measured on the shortest cold effectiveness stop at GVWR (m/s)

V = cold effectiveness test speed (km/h)

Dc = the average deceleration actually achieved during the shortest cold effectiveness stop at GVWR (m/ss)

S = stopping distance.

B. In addition to the requirement above, the stopping distance for at least one of the two hot stops must be $\leq$ 89 m from a test speed of 100 km/h or, for reduced test speed $\leq 0.10V + 0.0079V^2$. The results of the second stop may not be used to meet the requirements of the first stop.

NOTE 1: Accelerate as rapidly as possible to the initial test speed immediately after each stop.

NOTE 2: Immediately after the hot performance stops, drive 1.5 km at 50 km/h before the first cooling stop.

VISUAL DATA

Stop No.	Test Speed (km/h)	Initial Brake Temperature (C)		Stopping Distance (m)	Stopping Direction	Pedal Force (N)	Vehicle Decel. (m/s^2)	Wheel Lockup	Stay in Lane
		Front	Rear			Maximum	Maximum		
1									
2									

Comments:

19. DATA SHEETS ....Continued

RECORDED DATA

Stop No.	Test Speed (km/h)	Initial Brake Temp. (C)		Stopping Distance (m)	Pedal Force (N)			Vehicle Decel. (m/s²)		Wheel Lockup
		Front	Rear		Min.	Max.	Avg.	Max.	Avg.	
1										
2										

COMPLIANCE: YES _____ NO _____

Comments:

DRIVER_____ OBSERVER_____

DATE: _____

19. DATA SHEETS ....Continued

DATA SHEET 28
15.22 BRAKE COOLING @ GVWR (S7.15)

VEHICLE:		NHTSA NUMBER:		DATE:	
TEMP.:		WIND VELOCITY:		ROAD PFC:	
ODOMETER START:		ODOMETER FINISH:			

Test Weight: Total = ____ kg; Front = _____ kg; Rear = _____ kg

S7.15 Brake Cooling Stops: GVWR

IBT: Temperature achieved at completion of hot performance.

TRANSMISSION POSITION: In gear

NUMBER OF RUNS: 4 stops

TEST SPEEDS: 50 km/h

PEDAL FORCE:
Adjust as necessary to maintain specified constant deceleration rate

DECELERATION RATE:
Maintain a constant deceleration rate of 3.0 m/s²

WHEEL LOCKUP:
No lockup of any wheel for longer than 0.1 seconds at speeds > 15 km/h

NOTE 1: Immediately after the hot performance stops, drive 1.5 km at 50 km/h before the first cooling stop.

NOTE 2: For the first through third cooling stops, immediately accelerate at the maximum rate to 50 km/h. Maintain that speed until beginning the next stop at a distance of 1.5 km from the beginning of the previous stop.

NOTE 3: Immediately after the fourth stop, accelerate at the maximum rate to 100 km/h. Maintain that speed until beginning the recovery performance stops at a distance of 1.5 km after the beginning of the fourth cooling stop.

19. DATA SHEETS ....Continued

VISUAL DATA

NOTE: Modify as needed according to instrumentation.

Stop No.	Test Speed (km/h)	Max. Decel. Rate (m/s²)	Max. P.F.	Brake Lining Temperatures				Comments:
				LF	RF	LR	RR	
1								
2								
3								
4								

Comments:

RECORDED DATA

Stop No.	Test Speed (km/h)	Avg. Decel. Rate (m/s²)	Avg. P.F.	Brake Lining Temperatures				Comments:
				LF	RF	LR	RR	
1								
2								
3								
4								

COMPLIANCE: YES _____ NO _____

Comments:

DRIVER_____ OBSERVER_____

DATE: _____

19. DATA SHEETS ....Continued

DATA SHEET 29
15.23 Recovery Performance @ GVWR (S7.16)

VEHICLE:		NHTSA NUMBER:		DATE:	
TEMP.:		WIND VELOCITY:		ROAD PFC:	
ODOMETER START:		ODOMETER FINISH:			

Test Weight: Total = _____ kg; Front = _____ kg; Rear = ____ kg

S7.16 Recovery Performance. GVWR

NOTE: The recovery performance test is conducted immediately after completion of the brake cooling stops.

IBT: Temperature achieved at completion of cooling stops.

TRANSMISSION POSITION: In neutral.

NUMBER OF RUNS: 2 Stops

TEST SPEED:
100km/h. If vehicle is incapable of attaining 100 km/h, it is tested at the same speeds used for the cold effectiveness test.

PEDAL FORCE:
Average pedal force not greater than the average pedal force recorded during the shortest GVWR cold effectiveness stop. _____N

WHEEL LOCKUP:
No lockup of any wheel for longer than 0.1 seconds allowed at speeds greater than 15 km/h.

Immediately after the 4th cooling stop, accelerate at the maximum rate to 100 km/h. Maintain that speed until beginning the 1st recovery performance stop at a distance of 1.5 km after the beginning of the 4th cooling stop.

Immediately after completion of the 1st recovery performance stop, accelerate as rapidly as possible to the specified test speed and conduct the 2nd recovery performance stop.

19. DATA SHEETS ....Continued

Performance Requirements: The stopping distance (S-0.10V) for at least one of the two stops must be within the following limits:

S - 0.10V $\leq$ (0.0386 V² / 1.50Dc), and

S - 0.10V $\leq$ (0.0386 V² / 0.70Dc), where —

V = cold effectiveness test speed (km/h)

Dc = average deceleration actually achieved during the shortest cold effectiveness stop at GVWR (m/ss).

VISUAL DATA

Stop No.	Test Speed (km/h)	Initial Brake Temperature (C)		Stopping Distance (m)	Stopping Direction	Pedal Force (N)	Vehicle Decel. (m/s²)	Wheel Lockup	Stay in Lane
		Front	Rear			Max.	Max.		
1									
2									

Comments:

RECORDED DATA

Stop No.	Test Speed (km/h)	Initial Brake Temp. (C)		Stopping Distance (m)	Pedal Force (N)			Vehicle Decel. (m/s²)		Wheel Lockup
		Front	Rear		Min.	Max.	Avg.	Max.	Avg.	
1										
2										

COMPLIANCE: YES _____ NO _____

Comments:

DRIVER:_____ OBSERVER:_____

DATE: _____

19. DATA SHEETS....Continued

DATA SHEET 30 (Part 1 of 5)
15.24 TEST COMPLETION INSPECTION (S7.17)

VEHICLE: _____ ; NHTSA NO.: _____ ; DATE: _____

TEMPERATURE: _____ ºC; WIND VELOCITY & DIRECTION: _____

TEST COMPLETION INSPECTION REQUIREMENTS:

A. No detachment or fracture of any component such as brake springs, brake shoes, or disc pad facings.

B. All mechanical components shall be intact and functional.

C. Friction facing tearout shall not exceed 10% of the lining on any single frictional element.

D. No visible brake fluid or lubricant on the friction surface of the brake. No leakage at any system reservoir cover, seal, or filler opening.

19. DATA SHEETS ....Continued

System Integrity (S5.6)

Friction Material Condition: Primary/Inner		**Friction Material Condition: Secondary/Outer**	
LF		LF	
RF		RF	
LR		LF	
RR		RR	
Drum (or Rotor) Condition:		**Brake Fluid/Lubricant Inside Brakes:**	
LF		LF	
RF		RF	
LR		LR	
RR		RR	
Hydraulic Component Condition:		**Mechanical Component Condition:**	
LF		Brk/Pedal	
RF		Power Brk	
LR		Stop/Lamp	
RR		Linkage	
M/Cyl		Other	

COMPLIANCE: Yes _____ No _____No Reqmts _____

Comments:

Technician:_____ Date:_____

19. DATA SHEETS....Continued

DATA SHEET 30 (Part 2 of 5)
15.24 TEST COMPLETION INSPECTION (S7.17)

VEHICLE: _____ ; NHTSA NO.: _____ ; GVWR: _____lb

MASTER CYLINDER RESERVOIR:

DATE		Requirements	Pass	Fail
Reservoir Compartments (S5.4.1)				
(1) Does master cylinder have a reservoir compartment for each brake subsystem?	Yes	Master cylinder shall have a reservoir compartment for each subsystem.		
	No			
(2) Does loss of fluid in one compartment result in complete loss from another compartment?	Yes	Loss of fluid from one compartment shall not cause complete loss from another compartment.		
	No			
Reservoir Capacity (S5.4.2) **NOTE:** Reservoir total minimum capacity is defined as Total Capacity of Reservoir.				
Shall conform to requirements (1) or (2), state units: (1) For reservoirs having completely separate compartments for each subsystem (two separate, independent reservoirs):				
Subsystem 1 Subsystem reservoir capacity		Each compartment (reservoir) shall have a minimum capacity equivalent to the fluid displacement resulting when all wheel cylinders or caliper pistons serviced by that independent compartment/reservoir moves from a new lining, fully retracted position to a fully worn, properly adjusted, fully applied position. **(Use Data Sheet 31 and Appendix 1A)**		
Subsystem 1 Fluid displaced from new to worn lining				
Subsystem 2 Subsystem reservoir capacity				
Subsystem 2 Fluid displaced from new to worn lining				
2) For reservoirs utilizing a portion of the reservoir for a common supply to two or more subsystems:				
Total minimum capacity for the entire master cylinder reservoir (includes individual compartment reservoirs)		Shall have total minimum capacity for entire reservoir for displacement resulting from all subsystem wheel cylinders or caliper positions moving from new lining to full worn condition as above.		
Fluid displaced from new to worn linings (ALL linings)				

Comments:

19. DATA SHEETS....Continued

DATA SHEET 30 (Part 3 of 5)
15.24 TEST COMPLETION INSPECTION (S7.18)

VEHICLE: _____ ; NHTSA NO.: _____

GVWR: _____ lb

MASTER CYLINDER RESERVOIR:

DATE		Requirements	Pass	Fail
Master Cylinder Piston Displacement(S5.4.2) [If Common Reservoir Supply - continued from previous page]				
Fluid displaced by three strokes of master cylinder piston for Primary (Subsystem No. 1)		Individual partial compartments of reservoir shall **each** have a minimum of fluid equal to at least the volume displaced by the master cylinder piston servicing the subsystem during a full stroke of the piston. **NOTE:** Procedure uses three strokes to ensure an accurate measurement.		
Fluid displaced by three strokes of master cylinder piston for Secondary (Subsystem No. 2)				
Fluid displaced per stroke, Primary				
Fluid displaced per stroke, Secondary				
Fluid available in partial compartment Subsystem No. 1				
Fluid available in partial compartment Subsystem No. 2				
Brake Power Unit Reservoir (S5.4.2)				
Volume displaced in charging system piston or accumulator to normal operating pressure plus wheel cylinder or caliper piston displacement.		Shall have a capacity at least equal to fluid displacement required to charge the system pistons on accumulators to normal operating pressure plus displacement when wheel cylinders or caliper pistons move from new lining to full worn condition as above.		
Reservoir Labeling (S5.4.3)				
Exact copy of reservoir label:		Label shall read: "Warning, clean filler cap before removing; use only * fluid from a sealed container". * Fluid type specified in 49 CFR 571.116		
Measure letter height		Letters shall be at least 3.2mm/ 0.125" high		
Describe label attachment method and location.		Lettering shall be permanently affixed, engraved or embossed and located so as to be visible by direct view either on or within 100mm/3.94 inches of the brake fluid reservoir filler plug or cap.		
Does the lettering contrast with the background?	Yes	If label is not engraved or embossed, letters shall be of a color that contrasts with the background		
	No			

19. DATA SHEETS ....Continued

DATA SHEET 30 (Part 4 of 5)
15.24 TEST COMPLETION INSPECTION (S7.18)

VEHICLE: _____ ; NHTSA NO.: _____ ; DATE: _____

BRAKE SYSTEM WARNING INDICATOR (S5.5)

CONDITION	ANSWER	REQUIREMENTS	PASS	FAIL
Brake Systems Indicator Lamp Function Check (S5.5.2) (Bulb and systems check)				
Describe location of brake indicator lamp:		Shall be in front, and in clear view, of driver.		
Does lamp light with ignition (start) switch at ON/RUN? Does lamp light with ignition between ON and Start?		Automatic activation when ignition switch is "on" when engine **not running**, or ignition between "on" and "start" if is manufacturer check position- OR -single manual action by driver		
Brake check description in owner's manual?		Manufacturer shall explain the brake check function test procedure in the owner's manual.		
Brake System Warning Indicator ACTIVATION (S5.5.1) DURATION (S5.5.3) FUNCTION (S5.5.4)				
CONDITION	**Light ON?**	**REQUIREMENT**	**PASS**	**FAIL**
A. In event of hydraulic leak (1) On or before appearance of pressure differential of 218 psi (split system)		When ignition (Start) switch is **ON**, lamp must light whenever (a), (b). (c), or (d), occurs. IN addition, if service brake system is not a split system, audible warning must be activated when any condition in (a) exists. Visual warning indicator for non-split systems must be flashing.		
(2) If any reservoir falls below either "safe" level or 25% of capacity, whichever is greater.				
(3) On or before supply pressure to brake power unit falls to 50%				
B. Electrical functional failure in an antilock or variable brake proportioning system. C. Application of the parking brake. D. Brake lining wear-out if optical warning _____ **Must have Audible alarm** if not split system and a condition in (a) above exists? If condition (a) (1) above exists, and light does not activate, then fluid reservoir must be **transparent** for fluid check without need for reservoir to be opened? (S5.4.4) Indicator lamps remain activated as long as condition exists - ignition "on", and engine on or off? _____ (S5.5.3 DURATION)) Visual warning - continuous or flashing?___ Audible warning -continuous or flashing?__				

19. DATA SHEETS....Continued

DATA SHEET 30 (Part 5 of 5)
15.24 TEST COMPLETION INSPECTION (S7.18)

VEHICLE: _____ ; NHTSA NO.: _____ ; DATE: _____

BRAKE SYSTEM WARNING INDICATOR LABELING (S5.5.5)

CONDITION AND REQUIREMENT	ANSWER NOTE: Standard requires that the answer to questions be YES	PASS	FAIL
Are visual indicators legible to driver in daylight and nighttime conditions when activated?			
Are visual indicator words 3.2mm (.125") high minimum? Record Height_____			
Visual indicator words and background contrasting colors, one of which is red. Record colors_____			
If split system is there one brake indicator? If yes does it say the word "Brake"?			
If not split system, is there a separate indicator for loss of fluid or fluid pressure? Does this indicator say "Stop-Brake Failure" ? Are the letters block and not less than 6.4mm (.25") in height? Record letter height_____			
If separate indicator for: 1. Low brake fluid per S5.5.1(a)(1), does indicator say "Brake Fluid"? NOTE: not required for mineral oil system Record wording_____ 2. Gross pressure loss per S5.5.1(a)(2), does indicator say "Brake Pressure"? Record wording_____ 3. Electrical functional failure in antilock or variable proportioning system per S5.5.1(b), letters and background contrasting colors one of which is yellow? Record colors_____ Does indicator say "Antilock" or "ABS" or "Brake Proportioning"? Record wording_____ 4. Parking brake per S5.5.1(c), does indicator say "Park" or "Parking Brake"? Record wording_____ 5. Brake lining wear-out per S5.5.1(d), does indicator say "Brake Wear"? Record wording_____ 6. For any other function? If yes, Record_____			

Comments:

Technician:_____ Date:_____

19. DATA SHEETS....Continued

DATA SHEET 31
CALCULATION OF MINIMUM RESERVOIR VOLUME REQUIREMENTS

BRAKE		**LINING**		
LOCATION	**TYPE**	**DESCRIPTION**	**MINIMUM THICKNESS**	**THICKNESS TO FULLY WORN (1) in.**
Left Front	Drum	Leading	Pretest	
		Primary	Post Test	
		Inboard	.	
	Disc	Trailing	Pretest	
		Secondary	Post Test	
		Outboard	.	
LINING CLEARANCE:	Diametral (2) -	Inboard -	Outboard -	
WHEEL CYLINDER DIAMETER (3)		CALIPER PISTON DIAMETER (3)		
SHOE CAGE DIAMETER (4) _____ ; CENTER POINT OF BRAKE ASSY TO CENTER POINT OF W.C.				
Right Rear	Drum	Leading	Pretest	
		Primary	Post Test	
		Inboard	.	
	Disc	Trailing	Pretest	
		Secondary	Post Test	
		Outboard	.	
LINING CLEARANCE:	Diametral (2)	Inboard	Outboard	
WHEEL CYLINDER DIAMETER (3)		CALIPER PISTON DIAMETER (3)		
SHOE CAGE DIAMETER (4)		CENTER POINT OF BRAKE ASSY TO CENTER POINT OF W.C.		
SUBSYSTEM 1 CONSISTS OF:	LF	LR	RF	RR
SUBSYSTEM 2 CONSISTS OF:	LF	LR	RF	RR
(1) MFRS RECOMMENDATIONS - REAR - TOP OF RIVET HEADS - FRONT - 1/32 INCH -				
(2) DRUM BRAKES, MEASURED AT HORIZONTAL CENTERLINE				
(3) MFRS DATA				
(4) RESET POSITION				

19. DATA SHEETS....Continued

DATA SHEET 32
(SAMPLE)

DATA FOR CALCULATION OF MINIMUM RESERVOIR VOLUME REQUIREMENTS

BRAKE		**LINING**		
LOCATION	**TYPE**	**DESCRIPTION**	**MINIMUM THICKNESS**	**THICKNESS TO FULLY WORN (1) in.**
Left Front	Drum	Leading	Pretest - 0.425	0.324
		Primary	Post Test - 0.403	
		Inboard - X	. - 0.022	
	Disc - X	Trailing	Pretest - 0.393	0.300
		Secondary	Post Test - 0.380	
		Outboard - X	. - 0.013	
LINING CLEARANCE:	Diametral (2) - N/A	Inboard - 0	Outboard - 0	
WHEEL CYLINDER DIAMETER (3) - N/A		CALIPER PISTON DIAMETER (3) - 2.38"		
SHOE CAGE DIAMETER (4) - N/A ; CENTER POINT OF BRAKE ASSY TO CENTER POINT OF W.C. - N/A				
Right Rear	Drum - X	Leading - X	Pretest - 0.206	0.122
		Primary	Post Test - 0.200	
		Inboard	. - 0.006	
	Disc	Trailing - X	Pretest - 0.238	0.179
		Secondary	Post Test - 0.231	
		Outboard	. - 0.007	
LINING CLEARANCE:	Diametral (2) - 0.030"	Inboard - N/A	Outboard - N/A	
WHEEL CYLINDER DIAMETER (3) - 0.750"		CALIPER PISTON DIAMETER (3) - N/A		
SHOE CAGE DIAMETER (4) - 9.45" ; CENTER POINT OF BRAKE ASSY TO CENTER POINT OF W.C. - 3"				
SUBSYSTEM 1 CONSISTS OF:	LF - X	LR	RF - X	RR
SUBSYSTEM 2 CONSISTS OF:	LF	LR - X	RF	RR - X
(1) MFRS RECOMD:	REAR - TOP OF RIVET HEADS -		FRONT - 1/32 INCH -	
(2) DRUM BRAKES, MEASURED AT HORIZONTAL CENTERLINE				
(3) MFRS DATA				
(4) RESET POSITION				

20. FORMS

INSTRUMENT CALIBRATION (12 MONTH MAXIMUM INTERVAL) (SAMPLE)

INSTRUMENT	SERIAL NUMBER	CALIBRATION DATE	NEXT CALIBRATION
Data Acquisition System			
Computer			
Software			
LF Torque Wheel			
Rf Torque Wheel			
LR Torque Wheel			
RR Torque Wheel			
LF slip Ring			
RF Slip Ring			
LR Slip Ring			
RR Slip Ring			
Pedal Force Transducer			
Park Brake Force Transducer			
LF Hydraulic Pressure Transducer			
RF Hydraulic Pressure Transducer			
LR Hydraulic Pressure Transducer			
RR Hydraulic Pressure Transducer			
Accelerometer			
Fifth Wheel			
Wind Velocity			
Ambient Temperature Gauge			
LF Brake Thermocouple			
RF Brake Thermocouple			
LR Brake Thermocouple			
RR Brake Thermocouple			
Fifth Wheel Velocity			
Lock-up Detection System			

QUALITY ASSURANCE_____

20. FORMS....Continued

DAILY INSTRUMENT CALIBRATION
(SAMPLE)

NOTE: A daily Pretest and Post test abbreviated instrumentation calibration is required per Section 8.

INSTRUMENT	(EXAMPLES) CALIBRATION PROCEDURE	DESIRED VALUE	INDICATED VALUE MORNING	INDICATED VALUE EVENING	ALLOWED DEVIATION
Velocity Meter	2.568 kHz Input				
5th Wheel Distance Meter	Drive Measured Distance				
5th Wheel Velocity Meter	Drive Measured Distance vs. Time				
Pedal Force Transducer	Dead Weight/Shunt				
Accelerometer	Known Accel. Or to Known Angles				
Brake Thermocouple					
Slip Ring					
Torque Wheel					
Lock-up Detector	Hand Spin Wheel Over 9.3 mph - Vehicle Stopped				

Comments:

TECHNICIAN:_____ QUALITY ASSURANCE:_____

DATE: _____

20. FORMS....Continued

LABORATORY NOTICE OF TEST FAILURE TO OVSC

FMVSS NO.: 135 TEST DATE: _____

LABORATORY: _____

CONTRACT NO.: DTNH22-_____ ; DELV. ORDER NO: _____

LABORATORY PROJECT ENGINEER'S NAME: _____

TEST VEH. MAKE/MODEL/BODY STYLE: _____

VEHICLE NHTSA NO.: _____; VIN: _____

VEHICLE MODEL YEAR: _____; BUILD DATE: _____

TEST FAILURE DESCRIPTION:

S135 REQUIREMENT, PARAGRAPH ___ :

NOTIFICATION TO NHTSA (COTR): _____

DATE: _____ BY: _____

REMARKS:

20. FORMS....Continued

MONTHLY TEST STATUS REPORT
FMVSS 135
DATE OF REPORT: _____

NO.	VEHICLE NHTSA NO., MAKE & MODEL	COMPLIANCE TEST DATE	PASS/ FAIL	DATE REPORT SUBMITTED	DATE INVOICE SUBMITTED	INVOICE PAYMENT DATE
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						

20. FORMS....Continued

MONTHLY VEHICLE STATUS REPORT
FMVSS 135
DATE OF REPORT: _____

NO.	VEHICLE NHTSA NO., MAKE & MODEL	DATE OF DELIVERY	ODOMETER READING	TEST COMPLETE DATE	VEHICLE SHIPMENT DATE	ODOMETER READING
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						

21. APPENDIX

APPENDIX 1

Procedure and Example for Determining Master Cylinder Volume Requirement

The procedure followed for determining the minimum volume requirements is outlined in the example shown below. The required data is taken from Table 1A-1.

V_r =	Volume required per wheel
C =	Manufacturer's recommended drum-to-lining clearance
Δt_p =	Change in thickness of primary lining
Δt_s =	Change in thickness of secondary lining
Y =	Center point of wheel cylinder to center point of brake assembly
A =	Cross sectional area of the wheel cylinder bore
NWC =	Number of wheel cylinders serviced by the reservoir in question

DETERMINATION OF MASTER CYLINDER MINIMUM VOLUME REQUIREMENTS

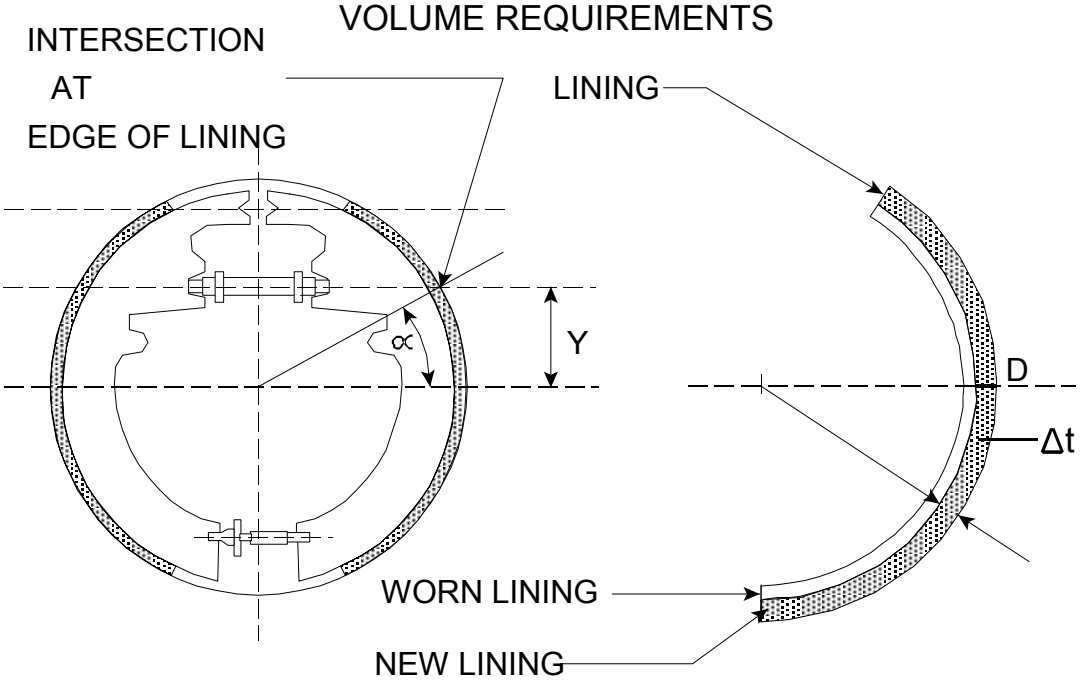

FIGURE 1A

DRUM BRAKES

Volume Required, $V_r = [(2C + \Delta t_s + \Delta t_p)/\cos] \times A \times NWC$, where –

V_r =	Volume required per wheel
C =	Manufacturer's recommended drum-to-lining clearance
Δt_p =	Change in thickness of primary lining
Δt_s =	Change in thickness of secondary lining
Y =	Center point of wheel cylinder to center point of brake assembly
A =	Cross sectional area of the wheel cylinder bore
NWC =	Number of wheel cylinders serviced by the reservoir in question
α =	$\sin^{-1}(2Y/D)$
D =	Cage diameter

APPENDIX 1A....Continued

DISC BRAKES

Volume Required, $V_v = (\Delta t_i + \Delta t_{ic} + \Delta t_o + t_{oc}) \times [\pi(D^2)]/4$, where –

V_v = Volume required per wheel
Δt = Change in thickness (average)
i = inboard
o = Outboard
D = Caliper cylinder diameter
c = Average clearance

Using the above equations, the volume requirements for Subsystem No. 1 (LF, RR) and Subsystem No. 2 (LF, RF) were calculated as shown below:

Drum Brakes (rear):

$V_r = (2C + \Delta t_p + \Delta_s \times 1)/\cos \alpha$
$C = 0.025$ in.
$\Delta t_p = 0.122$ in.
$\Delta t_s = 0.179$ in.
$D = 9.45$ in.
$\alpha = \text{Sin}^{-1} (2 \times 3)/9.45 = 39.4^\circ$; $\cos \alpha = 0.772$
$A = \pi \times (0.75)^2 = 0.44$ in.^{2}
$V_r = [(2 \times 0.025 \times 0.179 + 0.122)/0.772] \times 0.44$
$V_r = 0.13$ in.^{3} (2.1 ml)

Disc Brakes (front):

$V_r = (\Delta t_i + \Delta t_o + t_{ic} + t_{oc}) \times (\pi D^2)/4$
$\Delta t_i = 0.324$ in.
$\Delta t_o = 0.300$ in.
$t_{ic} = t_{oc} = 0$
$D = 2.38$ in.
$V_r = (0 + 0.324 + 0.300)[(\pi \times 2.38^2)/4]$
$V_r = 2.77$ in.^{3} (45.0 ml)

For System 1 (LF, RR)

$V_{r1} = 2.77$ in.^{3} + 0.13 in.^{3}
$V_{r1} = 2.90$ in.^{3} (47.1 ml)

For System 2 (LR, RF)

$V_{r2} = V_{r1} = 2.90$ in.^{3} (47.1 ml)

TOTAL VOLUME REQUIRED = $V_t = 5.8$ in.^{3} (94.3 ml)